FINAL

Appendix C-1

Field Sampling Plan

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LIST OF ACRONYMS

ACM	Asbestos-Containing Material
AHERA	Asbestos Hazard Emergency Response Act
AIHA	American Industrial Hygiene Association
bgs	Below ground surface
COC	Compound of Concern
DOT	Department of Transportation
EMSI	Engineering Management Support, Inc.
EPA	Environmental Protection Agency
FSP	Field Sampling Plan
HASP	Health and Safety Plan
IDW	Investigative-Derived Waste
LEL	Lower Explosive Limit
MMP	Materials Management Plan
MS/MSD	Matrix Spike/Matrix Spike Duplicate
ORP	Oxidation Reduction Potential
PAHs	Polynuclear-aromatic Hydrocarbons
% v/v	percent by volume
PID	Photo-ionization Detector
PLV	Polarized Light Microscopy
PVC	Poly-vinyl chloride
OU-2	Operable Unit #2
QAPP	Quality Assurance Project Plan
RAWP	Response Action Work Plan
SAP	Sampling and Analysis Plan
SPT	Standard Penetration Test
SWDI	Stormwater Design Investigation
TCLP	Toxicity Characteristic Leaching Procedure
TSDF	Treatment, Storage, and Disposal Facility

TSP	Tri-sodium Phosphate
UNCC	Utility Notification Center of Colorado
VAE	Visual Area Estimation
VOCs	Volatile Organic Compounds

1 INTRODUCTION

This Field Sampling Plan (FSP) presents the technical approach, methods, and procedures for a Design Investigation that supports design and implementation of the "environmental components" of an open channel stormwater drainage structure planned for Operable Unit 2 (OU-2) of the Vasquez Boulevard/Interstate 70 (VB/I-70) Superfund Site. Quality assurance measures related to field and laboratory activities conducted during the Design Investigation are described in the companion document to this FSP, the Quality Assurance Project Plan (QAPP). Together, this FSP and QAPP present the details of the field sampling and laboratory analytical and testing programs generally discussed the Sampling and Analysis Plan (SAP).

This FSP is organized as follows.

- Section 2 – Sampling Objectives
- Section 3 – Sample Location, Frequency, and Description
- Section 4 – Sampling Procedures and Equipment
- Section 5 – Sample Handling and Analyses
- Section 6 – Quality Assurance/Quality Control (refer to QAPP)
- Section 7 – Documentation

2 SAMPLING OBJECTIVES

Sampling objectives listed in Section 2 of the SAP are reiterated below:

- Determine the areal extent and depth of waste material along the footprint of the proposed barrier system alignment;

- Sufficiently characterize the waste material for offsite disposal. Non-hazardous, solid waste disposal at the Denver Arapahoe Disposal Site (DADS) will require demonstration that the material will pass RCRA characteristic screens for ignitability, corrosivity, reactivity (cyanide and sulfide screen), oxidizers, and paint filter test, and TCLP toxicity for VOCs, PAHs, lead, and arsenic. In addition, samples that might visually appear to contain asbestos will be assessed for friable asbestos;

- Determine the potentiometric surface of groundwater beneath and adjacent to the barrier system;

- Characterize the quality of groundwater that may be encountered during construction to determine the need for and type of treatment required during construction; and

- Assess the methane and total VOC concentrations of soil gas that may be encountered during excavation and materials handling.

3 SAMPLE LOCATIONS, FREQUENCY, AND DESCRIPTION

3.1 Sample Locations

Samples of waste material will be collected from 14 new borehole locations shown in purple on Figure C-1A. These borings will be **in addition** to the 10 geotechnical borings shown in green on Figure C-1A that were recently drilled by others to define the depth and thickness of waste material, and to assess geotechnical properties of waste material and underlying soil and bedrock. In addition, the ten geotechnical borings drilled by others have been temporarily cased as piezometers to collect an initial round of groundwater levels. The piezometer casings will be removed in July, 2015 – the approximate timeframe the Respondent will be conducting this Design Investigation. Results from the drilling, sampling, and groundwater level monitoring by others will be shared with Respondent for use by the Respondent in the barrier system design.

Collectively, the 24 borings (14 by Respondent and 10 by others) are located in the study area of the proposed stormwater drainage system. The number and spacings of the 14 new borings is intended to tighten the density of data points in closer proximity to the proposed channel alignment. The new boring locations are general and may be moved if restricted by access or buried utilities, but locations are intended to be within 50 to 200 feet of the centerline of the proposed drainage channel. The new borings will enable collection of RCRA-characterization information for off-site disposal of waste material, for chemical characterization of the waste material for barrier material compatibility, and if necessary, for additional shear and compressive strength testing of in-place material.

Temporary piezometers will be completed in each of the Respondent's new boreholes after soil samples have been collected. Groundwater levels will be gauged following piezometer construction. In addition, groundwater levels in existing wells MW-1, MW-2, MW-3, CTL MW-4, CTL MW-5, and CTL MW-6 (Figure C-1B) will be gauged. Groundwater samples will be collected from the Respondent's 14 new piezometers, plus existing wells and CTL MW-4, CTL MW-5, and CTL MW-6.

Monitoring for soil gas will be conducted at each boring location during drilling and sampling of the boreholes as well as at each piezometer/monitoring well during water level measurements and sampling.

3.2 Sample Frequency

The estimated numbers of waste samples, water level measurements, and groundwater samples are provided on Table C-1A.

3.3 Sample Description

It is anticipated that each of the new borings will be numbered with a prefix of SWDI, designating that they were constructed as part of the Storm Water Design Investigation (SWDI). For example: SWDI-12.

Waste material samples will be identified and numbered using a two-part numbering system that consists of the borehole number and the sample depth interval. For example, SWDI-12-4-9 would indicate that the sample was collected from boring SWDI-12 in the 4 to 9-foot depth interval.

A field duplicate sample will be identified by adding a "D" to the end of the boring number. For example, SWDI-12-4-9D would be a duplicate sample of the above sample.

Waste samples that are suspected of containing ACM will be labeled with an ACM suffix. For example: SWDI-12-4-9-ACM

The temporary piezometers will be designated with the same number as the borehole in which they are completed. Therefore, a groundwater sample collected from temporary piezometer SWDI-12 would be labeled SWDI-12. If the sample is filtered, the letter "F" will be added to the end of the sample number (e.g., SWDI-16F). A field duplicate of the filtered groundwater sample will be identified by adding a "D" to the end of the sample number (e.g., SWDI-16FD).

3.4 Sample Importance

Collection of all of the samples proposed in this FSP is important to establish a technically sound basis of design for this Removal Action. Specifically, the study area is underlain by a heterogeneous mixture of waste material, so variability of material type, depth, width, stability, and constituents will impact the basis of design for excavation and barrier construction. Similarly, variability in groundwater quality will impact the type of water treatment and/or offsite disposal required. Consequently, a high level of effort should be devoted to collect all of the field and laboratory data proposed in this FSP.

4 SAMPLING PROCEDURES AND EQUIPMENT

Procedures and equipment for utility clearance, surveying, borehole drilling and waste sampling, construction of temporary piezometers, gauging water levels, groundwater sampling, soil gas monitoring, decontamination and management of investigative derived waste, and borehole/piezometer abandonment are discussed in this section.

4.1 Health and Safety

Prior to performance of any field activities, all project personnel shall have read, understood, and agreed to comply with provisions of the Health and Safety Plan (HASP) (RAWP, Appendix E) for the design investigation. All design investigation activities will be conducted in accordance with the HASP. Necessary safety equipment will be readily available at the Site at all times during on-Site activities and will meet the requirements of NIOSH/OSHA. Use, maintenance, care, and calibration (if applicable) will be documented in the field logbook on a daily basis. All work will cease whenever health and safety requirements are not followed or if environmental conditions deteriorate to work cessation levels indicated in the HASP.

4.2 Surveying of Boring Locations and Utility Clearance

Prior to borehole drilling and sampling, the proposed boreholes will be located by a licensed surveyor and representative of EMSI. Locations of proposed borings will be marked on the pavement with spray paint, and in vegetated areas, with painted stakes. After locating the boreholes, the Utility Notification Center of Colorado (UNCC) [call 811], the Denver Wastewater Management Division https://www.denvergov.org/wastewatermanagement/WastewaterManagement/EngineeringandPermits/UndergroundUtility/tabid/440517/Default.aspx and the Metro Wastewater Reclamation District http://www.metrowastewater.com/know/PublicOutreach/Pages/utilitylocate.aspx will be contacted to conduct a utility locates and to clear the borehole locations prior to the start of drilling. If the location of a borehole is found to be within 10 feet of a utility corridor, then the borehole location will be moved to avoid potential impacts to the utility line. Of particular concern is the location of two existing large diameter sanitary sewer lines that transverse beneath the proposed stormwater drainage structure alignment (Figure C-1A).

4.3 Borehole Drilling and Logging

All boreholes will be drilled using 6.25" out-side diameter and 3.25" inside diameter hollow-stem augers. The drill rig will be equipped with a 140-pound standard penetration test (SPT) pneumatic hammer and 1.5-ft long California split-barrel samplers.

Barrel samples will be collected at 5-foot intervals beginning at five feet below ground surface (bgs). SPT blow counts for each sample will be collected. Between sampling intervals, drill cuttings and rig penetration rates will be observed to assess borehole lithology between barrel samples. Boreholes will be drilled through waste material into a minimum of 5-feet of underlying soil, weathered bedrock, or until auger refusal is encountered, whichever occurs first. At that depth, a final barrel sample will be collected.

Core samples retrieved from the boreholes will be logged using the ASTM Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) [ASTM D2488-06]. In addition, the samples will be described using geologic interpretations and observations. For example, the presence and characteristics of waste material, the types of primary and secondary porosity, and other features not included in ASTM procedures will be noted. A photoionization detector (PID) scan and odor observation of the core will be made. All geologic, physical observations, and PID information will be recorded on the borehole log that will be constructed for each borehole. A sample borehole log form is provided as Figure C-1C. Geotechnical information during drilling will also be noted on the log, including blow counts, auger penetration rate, first encounter of water, and other items of interest.

During drilling, the auger-flight collars will be monitored for the presence of organic vapors and explosive gases using a PID and 4-gas meter. The values measured will be recorded on the geologic log.

4.4 Solids Sampling

Four types of solids samples will be collected; samples for geotechnical testing (if determined to be necessary following review of the recently-collected geotechnical samples), samples for total chemical constituents, samples for TCLP testing, and samples for ACM testing. Each type is discussed below:

Geotechnical Testing: Geotechnical properties required for design include, but are not limited to, material classification, shear strength, moisture content, and swell or consolidation potential. This information is pertinent to the material that will remain in place that will effectively support the barrier system and overlying weight of the stormwater channel and retained groundwater. Therefore, if additional geotechnical samples are determined to be necessary, they will be collected from material that best represents foundation material underlying the barrier system. The number, type, and testing requirements for the samples will be determined in the field with consultation from the Geotechnical Engineer.

Total Chemical Constituents: Chemical constituent analyses will be necessary for selection of the barrier material. Accordingly, the sample depth should be immediately below that to which the barrier will be placed, to extent such placement can be estimated. One sample per boring will be collected using the barrel sampler. The sample will be screened for VOCs in the field, and analyzed for VOCs, PAHs, arsenic, and lead in the laboratory. A sample for each analysis will be placed in containers supplied by the analytical laboratory, the containers will be labeled and placed in a cooler filled with ice, and a chain-of-custody form (Section 7) will be completed. The samples will be delivered over-night to the analytical laboratory. Sample analytical methods, volumes, container types, preservation requirements, and holding times are listed on Table C-1B.

TCLP Testing; TCLP testing is necessary to pre-determine how and where excavated waste material will be disposed. Accordingly, the most representative sample type (except for VOCs) will be a vertical composite of the material estimated to be removed from the sample location. Compositing will involve collecting a uniform-size sample from each 5-foot interval sampled, placing each "sub-sample" into a one-time use plastic mixing bowl, and homogenizing them with a one-time use plastic spoon, knife or spatula. The composite sample will then be screened for hazardous characteristics consisting of ignitability, corrosivity, reactivity, oxidizers, and paint filter test in accordance with the procedures listed in Table C-1C. Composite samples for TCLP testing for PAHs and RCRA metals will be placed in jars supplied by the analytical laboratory. Because VOCs should not be composited, a single sample from a barrel interval that exhibits the highest PID reading will be collected and placed in a sample jar supplied by the laboratory and tested for TCLP VOCs.

All filled sample containers will be labeled, placed in a cooler filled with ice, and recorded on a chain-of-custody form (Section 7). The samples will be delivered over-night to the analytical laboratory. Sample quantities, types of container, sample preservation requirements, and holding times are listed on Table C-1B.

ACM Testing: Discussed below

4.5 Sampling of Suspected ACM

Any borehole cutting or barrel sample suspected of containing asbestos will be analyzed for asbestos content by Polarized Light Microscopy (PLM) visual area estimation (VAE) at an American Industrial Hygiene Association (AIHA) accredited laboratory. Friable materials containing asbestos estimated at less than ten percent by PLM-VAE may be reanalyzed by PLM point counting. Only one sample of each suspect material will be submitted per barrel sampler. If additional barrel samples have the same or similar material, those samples will be submitted for asbestos content by PLM analysis, only.

Sampling for ACM will be conducted by an EPA/Asbestos Hazard Emergency Response Act (AHERA) trained and accredited as a Colorado Certified Asbestos Building Inspector (CABI). Sampling will be conducted in general conformance with the method described in 40 CFR part 763.86 and the AHERA protocols. Sampling and analysis will comply with EPA's *Asbestos/NESHAP Regulated Asbestos-Containing Materials Guidance* (EPA, 1990).

The sampler will use a sampling tool (e.g., knife, spatula, tweezers) appropriate for each kind of material, collect the sample, place it in a separate sealed plastic bag, and take a photograph of the sample. Each sample will be individually numbered, and sample information will be entered onto a Field Data Sheet or in a field logbook. Sample tools will be decontaminated with low lint wipes after each sample collection.

The suspect ACM sample will be submitted under chain-of-custody (Section 7) to Aerobiology Laboratories, located in Golden, CO or an equally-certified testing facility. Samples will be analyzed in accordance with AHERA requirements using the following reference methods:

- EPA Interim Method for the Detection of Asbestos in Bulk Insulation Samples (EPA 600/M4-82020, December 1982); and
- McCrone Research Institute's *The Asbestos Particle Atlas*.

4.6 Piezometer Construction

After soil sampling, temporary piezometers will be constructed in each new borehole. Each piezometer will be constructed of 1-inch diameter, threaded, flush-joint, polyvinyl chloride (PVC) well casing. The piezometer will be screened from the base of the borehole to 12-inches above the first encounter of water when the borehole was drilled, and as projected based on water level data from nearby wells and piezometers. A 10-30 sand will be installed in the boring outside of the well screen and extend a minimum of two feet above the slotted interval. A minimum three-foot thick bentonite seal will be installed above the sand pack. The remainder of the borehole will be filled with drill cuttings or bentonite chips to approximately 6 inches bgs. The top of casing will then be cut off approximately 2 inches bgs, and the vertical and horizontal coordinates of the top of casing will be surveyed. A PVC cap will be placed on top of the casing, then a flush-mounted surface casing will be cemented in place over the top of the casing. The piezometer number will be painted on the surface cover of the flush-mounted casing.

After a period of at least 48-hours following completion of a temporary piezometer, it will be developed using a 0.75-inch diameter disposable bailer until water turbidity has stabilized.

4.7 Water Level Measurements

Water level measurements will be made using a battery-powered portable water level sensor with a polyethylene coated stainless steel flat tape graduated to the nearest 1/100th of a foot. The depth to water will be measured from the north side of the top of the PVC casing, and recorded in the field logbook. For the first water level measurement event, the total depth of each piezometer and existing well will also be measured and recorded. On subsequent water level measurement events, the total depth of only the piezometers will be measured. After water level and total depth measurements are collected, the sensor tape will be decontaminated using a solution of trisodium phosphate (TSP) or Alconox™ cleaning solution followed by rinsing with distilled water and air-drying.

4.8 Groundwater Sampling

Piezometers and monitoring wells will be purged and groundwater samples will be collected using disposable polyethylene bailers. Prior to purging and sampling, a water level measurement will be collected and the height of water column and standing volume of water in the well will be calculated. The well will be purged by removing a minimum of three (3) well casing volumes. After each one-half well volume is removed, a grab sample will be obtained and analyzed for pH, temperature, specific conductance, and oxidation/reduction potential (ORP) using a portable water quality meter. Field parameter results as well as the purge volume and time will be recorded on a Groundwater Sampling Field Data Sheet (Figure C-1D) or in the field logbook. The exact amount of purging will be determined in the field on the basis of recharge rate and/ or water quality parameters. If a well or piezometer does not recover to within 50% of its static level within 15 minutes of a purge, or if its field parameters stabilize to within 90% of the previous reading, the well or piezometer may be sampled without purging all three well casing volumes.

After purging, the time of sampling will be recorded on the Groundwater Sampling Form or in the field logbook and on the sample labels, and the sample containers will be filled (including those for field duplicate samples). Samples for analysis of dissolved metals will be field-filtered using 0.45 micron disposable filters and a peristaltic pump. Filled sample bottles will be placed in their respective coolers on ice until prepared for shipment to the laboratory. Sample analytical methods, volumes, container type, preservation requirements, and holding times are listed on Table C-1B.

After sample collection, the chain-of-custody form(s) will be completed, ice and packing material (if necessary) will be added to the coolers, and the chain-of custody form will be sealed in a plastic bag and taped to the underside of the lid of the cooler. Coolers will be custody-sealed and delivered to the laboratory.

4.9 Soil Gas Monitoring

Monitoring for soil gas using a calibrated PID and 4-gas meter will be performed during all borehole drilling and sampling activities, as well as during groundwater monitoring and sampling. Air monitoring conducted during this work will be documented on the Direct Reading Instrument Data Form (Figure C-1E) and subsequently filed with the project records in accordance with the Records Management Plan (SAP, Appendix C). The Data Form information may also be substituted for a meter data download if properly documented.

Air quality will be monitored in the breathing space adjacent to an open boring or completed well or piezometer, and at the top of the open boring, well, or piezometer during drilling and water quality sampling. Air will be monitored for 1) total VOCs using a calibrated hand-held PID, and 2) oxygen content, combustible gas levels, carbon monoxide (CO), and hydrogen sulfide (H_2S) using a calibrated hand-held 4-gas meter.

Air monitoring for total VOCs will be conducted continuously during all activities when there is potential exposure to oxygen deficiency, explosive vapors, methane, CO, H_2S, or VOCs. Levels will be logged hourly during continuous monitoring.

The 4-gas meter will have the ability to determine the level of explosive vapors, oxygen deficient environments, and CO and H_2S concentrations. The combustible gas indicator should have a range from 0 to 100 percent of the LEL. The oxygen sensor range should be from 0 to 40 percent, the CO sensor range 0 to 500 parts per million (ppm), and the H_2S range from 0 to 100 ppm.

4.10 Decontamination and Investigative Derived Waste (IDW) Management

The drill rig, auger flights, drill bits and soil sampling equipment will be pressure washed or steam cleaned prior to arrival on-Site. Following completion of each borehole, auger flights, drill bits, sampling rods, and soil coring equipment that have been used downhole, will be pressure washed over a portable wash basin. Management of the decontamination water will be performed in accordance with the MMP (RAWP, Appendix D).

All soil cuttings generated by drilling the boreholes will be containerized at the time of drilling. The containers will be labeled as to their contents with the borehole number and the date of drilling indicated on the label. The containers will then be transported to a central staging area designated by the EMSI Project Manager for screening and disposal in accordance with the MMP.

Management of liquids generated from well development, purging, and sampling will be performed in accordance with the MMP.

Used personal protective equipment (e.g., gloves, paper towels) will be placed in plastic garbage bags and disposed of as solid waste in accordance with the MMP.

4.11 Borehole/Piezometer Abandonment

All piezometers will be removed during construction of the barrier system. If the barrier excavation does not extend to the base of the piezometer casing, the remaining PVC casing will be removed and the open borehole will be backfilled with sand or bentonite.

5 SAMPLE HANDLING AND ANALYSIS

5.1 Sample Handling

Sample containers, volumes, preservation requirements, and holding times for specific analyses are shown on Table C-1B. Samples which must be stored at less than 6°C will be placed on ice in an insulated chest in the field. Designated containers or sample bottles received from the laboratory will already contain the requisite preservative and include a label indicating the preservative.

All sample containers will be labeled immediately after sealing. The label will identify the site name, sample number, sampler's initials, sampling date, time of day the sample was collected, analyses to be performed, and preservation used. This information along with any in-situ measurements or field observations will also be recorded in the field logbook or on the Borehole Log Form (Figure C-1B) or Groundwater Field Data Sheet (Figure C-1D).

Samples will be delivered to the designated laboratory for analysis. The EMSI On-site Representative (or Project Manager) will contact the laboratory to inform them of shipments before shipping samples. U.S. Department of Transportation (DOT) shipping requirements will be followed when applicable. Applicable procedures from ASTM D4220 – Practices for Preserving and Transporting Soil Samples will also be followed.

Samples will be packaged and shipped using the packing materials and insulated ice chests provided by the analytical laboratory. Sample containers should be placed in the plastic bubble wrap pouches and/or foam insulation materials provided by the laboratory and placed in the ice chest. Additional foam insulation material should be placed below, between, and above samples to prevent movement of the samples during transport. Enough room should be provided on top of the samples and underneath the lid of the ice chest for ice. Ice should be placed in several one-gallon zip-lock plastic bags and placed on top of the samples.

Chain-of-custody (COC) records describing the contents of the ice chest will be placed in a sealed plastic bag and taped to the inside of the ice chest lid. The lid will be closed, securely taped, and sealed with a custody seal. The custody seals will be signed and dated by the sampler.

In some cases, sealed ice chests may be picked up by a courier or dropped-off for shipment before the samples are chilled to the required temperature. In this case, samples need to be well-chilled during transport and the temperature of each sample should not be greater when received by the laboratory than when it was collected.

The samples will be shipped under chain-of-custody in ice chests by an EMSI representative, a courier, or by an overnight shipping service. If the samples are transported by a courier or overnight shipping service, a bill of lading will be used. Bills of lading will be retained as part of the permanent documentation in the project file.

5.2 Sample Analysis

As discussed in the text above, samples will be analyzed for the parameters using the methods indicated on Table C-1B. Chemical analysis of solids and groundwater samples will be performed by TestAmerica-Denver. Analysis of any asbestos analysis will be conducted by Aerobiology Laboratories or an equally-certified testing facility Turn-around times of 10 business days will be requested. If additional geotechnical testing is determined to be necessary, it will be conducted by CTL Thompson in their Denver testing laboratory. All of the laboratories will be responsible for disposition of samples following completion of sample analyses or testing.

6 QUALITY ASSURANCE/QUALITY CONTROL

6.1 Field Quality Control

The drilling of the boreholes, geologic logging of the boreholes, soil sample collection, piezometer construction and development, water level measurements, groundwater sampling, sample handling, and piezometer abandonment will be conducted in accordance with the procedures discussed in Section 4 of this FSP.

6.2 Quality Control Samples

Waste Material/Visibly-Impacted Soil

One co-located field duplicate sample will be collected for each 20 investigative samples or analytical batch whichever is more frequent. A duplicate sample from the composited samples that will be analyzed for metals will be obtained by filling separate sample bottles from the homogenized composite soil sample. In the case of discreet samples for VOC analyses, a duplicate sample will be obtained by splitting the individual sample into two parts at the time of filling the sample bottles.

One sample for each batch of investigative samples will be designated as a matrix spike/matrix spike duplicate (MS/MSD) sample. In the case of metals analyses, MS/MSD samples from the composited samples will be obtained by filling two additional sample bottles from the homogenized composite solids sample. The MS/MSD samples of discrete samples for VOC analyses will be obtained by splitting the individual samples into three parts at the time of filling the sample bottles.

Groundwater/Liquid

Similar to solid samples, one co-located field duplicate sample will be collected for each 20 investigative samples or analytical batch whichever is more frequent. This includes samples for VOCs, PAHs, dissolved metals, and total metals analyses. Duplicate samples for all parameters will be obtained by pouring equal volumes of liquid from each sampling bailer into the sample bottles. For field-filtered samples, the same procedure will be followed when filling the filtration unit prior to filtration, and when filing samples bottles after filtration.

One sample for each batch of investigative samples will be designated as a matrix spike/matrix spike duplicate (MS/MSD) sample. Sample collection will be the same as for duplicate sampling.

With respect to VOC trip blanks, one trip blank sample will be submitted per 20 samples, or one per sample cooler.

The sample results will be subject to a Level III data validation consisting of the following elements:

- Methodology,
- Holding times,
- Blanks,
- Spikes,
- Duplicates, and
- Surrogates.

7 DOCUMENTATION

7.1 Field Notebook

Documentation of field activities will occur through the use of a field notebook that will be in the possession of the field geologist or engineer during all field activities. The following information will be contained in the field notebook.

- Name of person(s) making entries
- Date of field activities
- Summary of activities conducted on the particular day
- Summary of calibration information for instruments calibrated in the field
- Identification of any visitors on site and the times of when they arrived and departed
- Description of site conditions (e.g. weather, surface conditions)
- Deviations, if any, from planned activities or procedures set forth in the SAP.

7.2 Borehole Log

The geologic and subsurface conditions at the Site will be documented through the use of the borehole log. A sample of a borehole log form is provided as Figure C-1C.

7.3 Groundwater Sampling Sheet

The groundwater sampling sheet to be used is provided as Figure C-1D.

7.4 Direct Reading Instrument Form

The direct reading instrument data sheet to be used in provided as Figure C-1E.

7.5 Chain-of-Custody Form

All waste material/soil and groundwater samples collected at the Site will be collected under Chain-of-Custody procedures. As previously stated, with the exception of determination of asbestos content and geotechnical testing of soil samples, TestAmerica Denver will perform all analytical work on this project. A copy of the TestAmerica Chain-of-Custody form that is provided by the laboratory is included as Figure C-1F.

Chain-of-custody forms for the asbestos and geotechnical testing laboratories will be obtained prior to beginning fieldwork.

Tables

Table C-1A: Anticipated Number and Type of Samples

Type of Sample	Estimated Number of Investigative Samples	Number of Field Duplicate and MS/MSD Samples
Waste Material/Visually-Impacted Soil		
Total VOCs	14	3
Total PAHs	14	3
Total Arsenic	14	3
Total Lead	14	3
TCLP VOCs	14	3
TCLP PAHs	14	3
TCLP RCRA metals	14	3
Asbestos Containing Material (ACM)	Unknown, collect if suspected	
Soil for Geotechnical Properties Analysis	TBD	TBD
Water Level Measurements		
Weekly for one month, then Monthly for 5 months, weather permitting	18 (per event)	
Groundwater Samples		
VOCs	14	3
PAHs	14	3
Total Metals	14	3
Dissolved Metals	14	3
Monitoring for Soil Gas	Continuous monitoring during drilling and sampling	

Table C-1B: Analytical Methods, Sample Container Type, Preservation Requirements, and Holding Times

Media	Analysis	Method	Sample Container/Quantity	Preservation	Holding Time
Soil	Percent Moisture	ASTM D-2216	4 ounce glass; 20 grams	Cool < 6°C	28 days
Soil	VOCs	SW-846 8260B	4 ounce glass with Teflon-lined lid; 60 grams	Cool < 6°C	14 days
Soil	PAHs	SW-846 8270C SIM	4 ounce glass; 60 grams	Cool < 6°C	14 days to extract – 40 days to analyze
Soil	Arsenic and Lead	SW-846 6010C	4 ounce glass; 20 grams	Cool < 6°C	180 days
Soil	TCLP VOCs	SW-846 1311 SW-846 8260B	4 ounce glass with Teflon-lined lid; 60 grams	Cool <6°C	14 days
Soil	TCLP PAHs	SW-848 1311 SW-846 8270C	4 ounce glass; 60 grams	Cool <6°C	14 days to extract – 40 days to analyze
Soil	TCLP 8 RCRA Metals	SW-846 1311 SW-846 6010C 7470B (mercury)	4 ounce glass; 20 grams	Cool < 6°C	180 days (7 metals) 14 days (mercury)
Asbestos	Asbestos content	Polarized Light Microscopy EPA/M4-82020	Plastic bag; quantity varies	None	Indefinitely
Soil	Geotechnical properties	TBD	TBD	None	TBD

Table C-1B (cont'd)

Media	Analysis	Method	Sample Container/Quantity	Preservation	Holding Time
Groundwater	VOCs	SW-846 8260B	3, 40 millimeter glass VOA vials	Cool < 6°C (not acidified)	7 days
Groundwater	PAHs	SW-846 8270C SIM	2, 1 liter amber glass	Cool < 6°C	7 days to extract – 40 days to analyze
Groundwater	Metals (totals and dissolved [1/])	SW-846 6010C 7470B (Hg) 7196A (Cr VI))	500 ml polyethylene	Cool < 6°C Nitric Acid	180 days 28 days (Mercury) 24 hrs (Cr VI)

[1/] Metals consist of arsenic, cadmium, chromium (III), chromium (VI), copper, iron, lead, manganese, mercury, nickel, selenium, silver, and zinc

Table C-1C: Waste Characterization Field Screening Procedures

Characteristic	Procedure
Ignitability	A waste is ignitable if it has a flash point below 140 degrees Fahrenheit. Each waste will be screened by exposing a sample to an open flame generated using a propane source. If the sample supports combustion, it will be classified as ignitable. Confirm result with SW1030.
Corrosivity	A waste is corrosive if it is aqueous and has a pH less than or equal to 2.0 or greater than or equal to 12.5. All waste will be screened using pH paper. For non-liquid wastes, a 10 percent non-liquid waste in water slurry will be used. Confirm with SW9040C (pH) and SW1120 (corrosivity).
Reactivity	A waste is reactive if, upon addition of water, it reacts violently; forms potentially explosive mixtures; or generates toxic fumes, vapors, or gases in quantities sufficient to present a danger to human health or the environment. This testing includes cyanide and sulfide screening. Confirmation testing for either screen should be performed in accordance with SW846, Chapter 7.
Reactive Cyanides Screen	To a beaker containing approximately 20 milliliters (ml) of sample, enough caustic is added to bring the pH to 12 or 13; then 5 to 10 ml of 10 percent ferrous sulfate solution is added and stirred; 5 to 10 ml of 5 percent ferric chloride solution is then added; and enough concentrated sulfuric acid is slowly added to bring the pH down to 1.0 or less. A bright blue or green color indicates the presence of cyanide. This test can detect free cyanide and many complexed cyanides in concentrations down to less than 100 parts per million (ppm).
Reactive Sulfides Screen	To a beaker containing approximately 20 ml of sample, enough concentrated sulfuric acid is slowly added to bring the pH down to 1.0 or less. Immediately after adding the acid, a wet strip of lead acetate paper is held over the beaker while agitating the contents. If the paper turns brown or silvery black, the presence of sulfides in the sample is indicated. If there is no color change, then total sulfides are reported as nondetectable (i.e., less than 100 ppm).
Oxidizer Screen	All wastes will be screened for oxidizer potential using potassium iodide test paper. A blue color on the test paper is a positive test for oxidizers. No confirmation test is available.
Paint Filter Test	To a fine-mesh paint filter (mesh number 60 ± 5%) add 100 ml or 100 g of representative sample. Test at ≤ 25°C (room temperature). If any portion of the material passes through and drops from the filter within a 5-minute test period the material contains free liquids. Confirm with SW9095.

Figures